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The Role of Internet Engagement in the Health-knowledge Gap

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Abstract

The current research posits that education leads to differential levels of Internet engagement, which moderate the association between Internet use for health information and general health knowledge. Using a nationally representative survey that covers adults between the ages of 40 and 70 in the United States, it is found that education is positively related to Internet engagement. Also, Internet use has stronger associations with health knowledge for people exhibiting high Internet engagement than for people exhibiting low Internet engagement. The implications of these findings for research on both Internet use and knowledge gaps are discussed.

Keywords

Knowledge-gap Hypothesis; Digital Divide; the Internet; Internet Engagement; Health Knowledge

Numerous studies have reported that people with a high socioeconomic status (SES) tend to be healthier than those with a low SES (House & Williams, 2000). It has been argued that low-SES people have relatively poor health partly because of their lack of *health knowledge*. Even though health knowledge does not always translate into healthy lifestyles and disease-screening behaviors, it is no doubt a necessary condition for diverse healthy practices (Viswanath et al., 2006). To increase low-SES people's health knowledge, various agents have made public-health efforts such as disseminating health information through mass-media channels (Rimal, Flora, & Schooler, 1999).

However, the *knowledge-gap hypothesis* posits that media information does not equally benefit population subgroups and that this inequality may restrict the effectiveness of public health campaigns. Even though mass media constantly infuse health information into society, individuals with low SES have been found to acquire knowledge from the media more slowly than those with high SES (Gaziano, 1997; Tichenor, Donohue, & Olien, 1970). Therefore, as health information enters a society through the media, the preexisting health knowledge gap between the society's haves and have-nots widens.

Recently, the Internet has become a crucial health-information source for the general public (Cline & Haynes, 2001; Lee, 2008). However, few studies have tested whether the readily accessible, increasing amount of online information enlarges the preexisting knowledge gap among different SES segments of the population. Because inequalities in ICT use merit our attention insofar as they actually bring about differences in terms of one's life chances,

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health, and social participation (DiMaggio, Hargittai, Celeste, & Shafer, 2004; Selwyn, 2004a), the lack of empirical research on the effects of Internet use is somewhat surprising. Moreover, several researchers have expressed concern that, because of the heterogeneous information supply and the unequal access and usage that characterize the Internet, knowledge-acquisition inequalities between SES groups might be more evident on the Internet than in other mass media (Bonfadelli, 2002).

Therefore, the current research examines whether people with high education levels gain more general health knowledge from the Internet than people with low education levels, even if the frequency of the two groups' Internet use is the same.[1] Because older adults are more vulnerable to diverse health threats than are younger adults (Adams, Stubbs, & Woods, 2005), the current research focuses on adults between the ages of 40 and 70. It is even more important that, as a response to Gaziano's (1997) call for "more focus on processes contributing to gaps" (p. 253), the current research tries to reveal the mechanism of the knowledge gap in the case of the Internet by taking into account the relationship that individuals have developed with the Internet (Bucy & Newhagen, 2004; Jung, Qiu, & Kim, 2001; Selwyn, 2004a). To this end, the current research develops the construct of *Internet engagement* and examines whether the extent to which one engages with the Internet moderates the association between Internet use for health information and health knowledge. The Internet engagement is fully elaborated below; however, it can briefly be described as a composite of psychological comfort, heterogeneity and frequency of use, length of use, and other elements.

Health-knowledge Gap on the Internet

Before proposing the "health-knowledge gap" hypothesis with regard to the Internet, it should be noted that there are three ways to empirically test the knowledge-gap phenomena. First, as Tichenor et al. (1970) suggested, one can conduct a longitudinal analysis of changes in the relationship between SES and knowledge over time. Second, Tichenor et al. also provided an alternative approach using a cross-sectional dataset. Without a longitudinal dataset, more than two issues—each having a different level of media publicity—could be employed and be compared in terms of the relationship between education and knowledge across the issues.

Third, a group of scholars proposed another method to deal with cross-sectional data and a single issue (e.g., Eveland & Scheufele, 2000; Kwak, 1999). They examined whether the association between education and knowledge is different depending on the levels of media use. That is, they measured individuals' media use as an "individual-level counterpart to varying media publicity" (Gaziano, 1997, p. 242). As Eveland and Scheufele stated, this approach has some advantages in that it "provides a more precise estimate of actual exposure to information than does the more macro measure of media publicity" (p. 219). Moreover, this approach is very useful in examining whether knowledge gaps occur online,

[1]The current research uses education as a surrogate for SES for two reasons. First, education is most frequently relied upon in previous studies of the knowledge gap (Gaziano, 1997). Second, many studies have found that after one obtains access to the Internet, education rather than income becomes more important in determining the pattern of Internet use and its consequences (Robinson, DiMaggio, & Hargittai, 2003; van Dijk, 2005).

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insofar as information on the Internet does not automatically lead to individuals' exposure to that information because "the Internet requires more active engagement of users than television or newspaper, and incidental exposure to information is less likely to occur online" (Shim, in press, p. 12).

Based on these considerations, the current research adopts the third individual-level method. Thus, the following hypothesis is derived:

Hypothesis 1: There will be interactive effects of *Internet use for health information* and *education* on *general health knowledge*, such that the association between *Internet use* and *health knowledge* is stronger for people with high levels of *education* than for people with low levels of education.

Mechanisms of the Health-knowledge Gap

Above and beyond just showing the existence of knowledge gaps, several scholars (e.g., Grabe, Lang, Zhou, & Bolls, 2000) have wrestled with the underlying reasons for the knowledge gap ever since Tichenor et al. (1970) provided several preliminary explanations. These scholars have found several factors that mediate the effects of education on knowledge acquisition. The factors can be categorized into the following five groups.

First, *communication skills* and *information-processing abilities* differ among SES groups. Compared to low-SES people, high-SES people are likely to have better reading skills and comprehension abilities, which are necessary to understand media content. Also, previous studies have shown that people with high levels of communication skills are more likely than people with low levels of communication skills to process media information in a more elaborate way, which facilitates knowledge acquisition from media (e.g., Eveland, 2002; Grabe et al., 2000).

A differing amount of *prior knowledge* regarding the issue at hand is a second reason for the knowledge gap. It has been found that people with high levels of education tend to have prior knowledge of media-presented topics, which helps them process and comprehend the relevant media information (e.g., Hsu & Price, 1993).

Third, people with high SES tend to know more people who are knowledgeable about media-covered topics than do people with low SES; thus, the former category of people are able to discuss and make sense of media information more quickly than the latter category of people. This finding has been supported by the "differential gains" studies in political communication (e.g., Scheufele, 2002), which showed that interpersonal political discussion amplifies the effects of public-affairs media use on political knowledge.

Fourth, the *selective exposure/attention* explanation assumes that low-SES people are more likely to use media for entertainment than are high-SES people, who are more likely to consume media for information gains than are low-SES people. Because people in low-SES groups use media for information acquisition less frequently than do their high-SES counterparts, the members of the former group are less likely to acquire knowledge from their media use than the members of the latter group (e.g., McLeod & Perse, 1994).

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Fifth, a group of scholars have focused on individuals' motivation, such as issue interest and issue involvement, as a causal link between SES and knowledge acquisition from mass media (e.g., Bonfadelli, 2002; Ettema, Brown, & Luepker, 1983). As Ettema and colleagues stated, "the sort of information disseminated by the mass media…is *not* so complicated that it requires highly sophisticated information processing skills. This information is, however, probably of more interest and use to higher SES individuals" (p. 517).[2] That is, these scholars argue that SES relates not so much to communication skills and to information-processing abilities as to differential interest in media information, a difference that eventually causes gaps in knowledge acquisition across SES groups.

To examine the process of the health-knowledge gap with regard to the Internet, the current research refines the first explanation (i.e., communication skills and information-processing abilities). Notably, there are several ways to extend the previous discussions on this topic. On the one hand, one can elaborate on the types of skills required for effective Internet use (e.g., van Dijk & Hacker, 2003), examine their roles in Internet use (e.g., Eveland, Marton, & Seo, 2004), and explore their antecedents and consequences (e.g., Hargittai, 2004a). On the other hand, one can focus on a larger social environment where Internet-use skills are put into use, and thus can elaborate on the structural and psychological antecedents of these skills. This approach "expands the technology-individual relationship into the context of a broader social structure" (Jung et al., 2001, p. 513), which "allows more thorough appreciation of different relationships people may have with media" (Loges & Jung, 2001, p. 539). The current research adopts the latter approach, assuming that Internet-use skills or online skills could be regarded as one sub-dimension or as one outcome of Internet engagement. Therefore, rather than measure individuals' Internet-related skills, the current research focuses on the *engagement* that one has with the Internet as a moderator of the association between Internet use for health information and health knowledge.

In sum, the current research contends that one pathway from education to the health-knowledge gap on the Internet is as follows: education affects Internet engagement, which in turn causes the health-knowledge gap on the Internet.

Internet-engagement Scale[3]

The current research develops a scale of *Internet engagement* by adopting, with a few modifications, the key assumptions of the Internet-connectedness model (Jung et al., 2001; Loges & Jung, 2001), the digital-inequality model (DiMaggio et al., 2004; Hargittai, 2004b), and hierarchical models of the digital divide and access to ICTs (Livingstone & Helsper, 2007; Selwyn, 2004a; van Dijk, 2005). To be more specific, the current study bases Internet engagement on the following interrelated premises. First, Internet engagement is more than just physical access to the Internet and time spent on the Internet. Despite the importance of

[2]There are three models (i.e., causal association, rival explanation, motivation-contingency) of motivation's roles in knowledge gaps (Chew & Palmer, 1994; Kwak, 1999; Viswanath, Kahn, Finnegan, Hertog, & Potter, 1993). It is beyond the scope of the current research to review all these models and to test them. Here, the causal-association model is briefly outlined because it is relevant to the current research.

[3]The Internet-engagement measure developed here is different from the Internet-engagement model that Norris (2001) proposed. Her Internet-engagement model examines the association between Internet use for political information and civic participation. In contrast, the Internet engagement in the current research reflects the relationship between the Internet itself and its users.

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these factors as valid indicators of the digital divide, they do not capture the *qualitative* aspects of individuals' Internet engagement (Jung et al., 2001; Livingstone & Helsper, 2007; Selwyn, 2004a; van Dijk, 2005). Redressing this oversight, the current research seeks to identify types of activities in which individuals engage while using computers and the Internet.

Second, assuming that individuals' media use is situated in the triangular relationship among individuals, society, and the media system (Ball-Rokeach & Jung, 2003), the current research considers (1) how long one has had access to computers and to the Internet, (2) the number of places where individuals use the Internet, and (3) what kind of Internet connection they have at home.

Previous studies have used Internet-adoption period as a valid indicator of individuals' connectedness to the Internet under the assumption that people's use of technology has, for a long time, enabled people to have a command of the technology (Jung et al., 2001; Loges & Jung, 2001). The places where one can access the Internet are also important because they are related to the control one has over the Internet (DiMaggio et al., 2004; Selwyn, 2004a). Using the Internet anywhere means more flexibility and greater autonomy over Internet use than accessing the Internet only in public places or at work. As DiMaggio et al. stated, "the greater the autonomy of use, the greater the benefits the users derive" (p. 389). Moreover, the number of sites at which one can access the Internet represents the extent to which one's residential area is suitable for Internet access and usage (Jung et al., 2001). In addition, Internet-connection speed has become more important since the early stages of Internet diffusion because speed has been found to predict the scope of possible online activities and the frequency of Internet use, even after education, income, and race/ethnicity are controlled for (DiMaggio et al., 2004). It has been found that, owing to older adults' relative lack of experience in ICT use, these factors are especially important in predicting the older adults' Internet-use patterns (Freese, Rivas, & Hargittai, 2006; Selwyn, 2004b).

Third, the current research considers the *psychological* aspects related to Internet use. Once people have a physical connection to the Internet, their perception of the Internet becomes more important because "physical access is meaningless unless people actually feel able to make use of such opportunities" (Selwyn, 2004a, p. 347). Moreover, there are psychological barriers to older adults' use of computers and, specifically, of the Internet, and these barriers include the adults' attitudes toward ICTs, computer anxiety, and low Internet efficacy (e.g., Adams et al., 2005; Morris, Goodman, & Brading, 2007; Selwyn, 2004b). Thus, the current research measures how *comfortable* one feels in using computers and the Internet, the level of comfort reflecting one's self-efficacy and one's perception of the ease of Internet use (van Dijk & Hacker, 2003).

Applying Internet Engagement to the Health-knowledge Gap

Using the Internet-engagement scale, the current research tests the hypothesized pathway from education to the health-knowledge gap in the case of the Internet. The current research first examines the association between education and Internet engagement.

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Previous digital-divide studies have demonstrated a robust relationship between education and multiple aspects of one's engagement with ICTs (Livingstone & Helsper, 2007; van Dijk, 2005). For example, Jung et al. (2001) conducted a survey that rested on a random-digit dialing method in seven neighborhoods in Los Angeles and revealed a positive relationship between education and Internet-connectedness score, a measure similar to the Internet-engagement scale. Likewise, Selwyn (2004a) showed that education is a critical factor in people's adoption of new ICTs, in people's subsequent use of them, and in people's usage patterns. Notably, a few studies surveying older Internet users found that education positively affects such aspects of Internet engagement as the users' having a high-speed Internet connection at home, the users' Internet-adoption period, and the frequency of the users' Internet use (e.g., Freese et al., 2006). Thus, the following hypothesis is derived:

Hypothesis 2: Individuals' *education* will be positively related to the *Internet-engagement scale*.

It is even more important that the current research examines whether or not Internet engagement moderates the effect that Internet use for health information has on health knowledge. Studies have found that, regarding various types of Internet-based learning information, only people who use the Internet often, and who thus have high Internet expertise, attained a strong understanding of public affairs from the Internet use; in contrast, people with low Internet expertise did not enjoy this advantage (e.g., Eveland et al., 2004). Similarly, other scholars have focused on *online literacy* or *Internet-search skills* and showed that these determine both the extent of learning from online sources and online-behavior patterns (e.g., Hargittai, 2004a; Livingstone & Helsper, 2007). Moreover, recent studies suggest that this determination is pronounced for older people because they are less familiar with the Internet than are younger people (e.g., Freese et al., 2006; Morris et al., 2007). Although these studies did not consider the complex relationship that individuals have developed with the Internet, these findings strengthen the expectation that the Internet will have a stronger effect on people exhibiting high levels of Internet engagement than on people exhibiting low levels of Internet engagement. This differential effect level is consistent with the research finding that many aspects of Internet engagement are closely related to Internet-search skills, in particular, and to digital skills, in general (DiMaggio et al., 2004). Thus, the current research puts forth the following hypothesis:

Hypothesis 3: There will be interactive effects of *Internet use for health information* and *Internet engagement* on *general health knowledge*, such that the association between Internet use and health knowledge is stronger for people exhibiting high levels of Internet engagement than for people exhibiting low levels of Internet engagement.

Methods

The current research used a nationally representative survey that covers adults between the ages of 40 and 70. Data were collected by Knowledge Networks (KN), a research firm that administers surveys via the Internet in respondents' homes. Respondents were chosen from a previously recruited KN panel of respondents and restricted to individuals who had been in the KN panel for less than two years. KN first selected participating households using a

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random-digit-dialing (RDD) sampling of U.S. households. If sampled households did not have Internet access, KN provided these households with free Web TV hardware and Internet access. The monthly recruitment rate for KN panel participation ranged from 18 to 25%, with an overall recruitment rate of 22%.

In total, 2,489 cases were collected from October 21, 2005 to October 25, 20006. Sampled panel members (and those recruited just for the current research) received an e-mail invitation and follow-up reminders to complete the survey. The survey instrument was pretested by 211 respondents in September, 2005. The weekly participation rates ranged from 61 to 84%, with an overall participation rate of 73%. The overall response rate, taking into account panel recruitment and survey participation, was 16%. The sample size for each analysis slightly varied because of missing data.

General Health Knowledge

General health knowledge was operationalized as an additive index of seven dichotomous items, asking respondents to indicate if the following statements were correct: (1) Doctors say that both types of cholesterol (called LDL and HDL) should be kept as low as possible; (2) if a person has a gene for a disorder, that person will always get the disorder; (3) the Human Papilloma Virus is associated with an increased risk of cervical cancer; (4) the body mass index (or BMI), used to measure obesity, is based on waist size and percent body fat; (5) there is currently a cure for cancer but the medical industry won't tell the public about it because they make too much money treating cancer patients[4]; (6) men are more likely to die because of prostate cancer than because of heart disease; and (7) treating cancer with surgery can cause it to spread throughout the body (KR-20 = .64, M = 3.29, SD = 1.90). The reliability is somewhat low partly because of the dichotomous nature of these scaled items.

Unlike political knowledge, it seems that there is no established measure of general health knowledge. Thus, in order to measure general health knowledge, at least for this particular age group (40–70), the current research adopted some items from previous studies on cancer (i.e., Gansler et al., 2005; Radosevich et al., 2004) and developed the other items. The above seven items were finally selected based on their distribution, face validity, nomological validity, and internal reliability through the pre-test.

Internet Use for Health Information

Internet use for health information was measured by asking respondents to rate themselves on a four point scale (1 = "not at all" to 4 = "two or more times per week"): "How often have you read health information on the Internet in the past 30 days?" (M = 2.05, SD = 1.03).

[4]One may argue that this question is more of a paranoia or myth than it is knowledge. The current research decided to include this item because this taps misinformation, which is as important as factual knowledge in examining health-knowledge gaps (Gaziano, 1997, p. 250). It should be noted that the results were essentially the same when the hypothesis was tested using the knowledge measure excluding this item.

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Internet Engagement

Internet engagement consists of the following six measures: scope of activities using the Internet and computers, Internet- (and computer-) adoption period, frequency of Internet use, comfort level in using the Internet and computers, Internet-connection speed, and site scope.

First, *scope of activities using the Internet and computers* was operationalized as an additive index of seventeen dichotomous items, asking respondents to indicate if they engaged in the following online activities: (1) audio or video editing; (2) finances (e.g., banking or paying bills); (3) checking news, weather, or sports; (4) creating web pages; (5) educational purposes; (6) job searches; (7) listening to or downloading music; (8) making phone calls; (9) participating in chat rooms or message boards; (10) playing games; (11) reading newsgroups; (12) searching for information; (13) sending instant messages; (14) shopping; (15) stocks (buying/selling, looking up quotes, etc.); (16) word processing; and (17) work purpose (KR-20 = .86; M = 4.34, SD = 3.82).

Second, *Internet- (and computer-) adoption period* was measured by asking respondents on a five-point scale how long they have been using (1) computers, (2) email, and (3) the Internet other than email. After these items were recoded into interval-level variables (i.e., "less than 6 months" = 6, "6 to 12 months" = 9, "1 to 2 years" = 18, "3 to 4 years" = 42, and "5 or more years" = 60), the answers to these three questions were averaged (α = .98; M = 45.54, SD = 20.44).

Third, *frequency of Internet use* was measured by asking respondents the following two questions: "In the past seven days, on how many days did you use the Internet for email?" and "In the past seven days, on how many days did you use the Internet, other than for email?" Then, the answers to these questions were averaged (r = .73; M = 4.43, SD = 2.48).[5]

Fourth, *comfort level in using the Internet and computers* is an averaged value of three five-point items (1 = "very uncomfortable" to 5 = "very comfortable") that asked how comfortable respondents felt in using (1) computers, (2) email, and (3) the Internet other than for email (α = .94; M = 3.80, SD = 1.31).

Fifth, *Internet-connection speed* was measured by asking respondents what kinds of Internet connection they had at home other than the Internet access that Knowledge Networks provided using a three-point scale (i.e., 1 = "no Internet connection," 2 = "Internet connection through a telephone modem," 3 = "Internet connection through advanced-quality device such as cable or satellite modem, DSL modem, and T1/T3 line"; M = 2.15; SD = .86).

Sixth, *site scope* was measured as the number of places where respondents use computers, based on the fact that most Internet users rely on computer as their main platform (DiMaggio et al., 2004; van Dijk, 2005). By asking whether respondents use the Internet at

[5]One may argue that the measure of the frequency of Internet use overlaps with the independent variable of the current research (i.e., the Internet use for health information). Although they are correlated with each other (r = .48), they are conceptually different in that the former taps general use of the Internet, whereas the latter taps content-specific (i.e., health information acquisition) use of the Internet. Also, as will be apparent below, this distinction is analytically productive. The general engagement variable moderates the effects of the specific content use variable.

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home, at work, and somewhere else (e.g., library and friends' house) respectively, dichotomous variables for each place were created and then added up (*M* = 1.21, *SD* = .73).

These final scale scores were entered into a principal component factor analysis. All six measures loaded on the first principal component (82, 80, 76, 69, 77, and 72, respectively). Thus, each of these six measures was standardized and then summed to compose an overall scale of *Internet engagement* (α = .85; *M* = .18, *SD* = 4.52).

Other Antecedent Variables

The current research controlled for demographics and other variables that have been shown to predict Internet use for health information and to influence the relationship between Internet use and health knowledge. Specifically, the current research included age (*M* = 52.85, *SD* = 8.40), gender (51.1 % females), formal education (median = high school graduate or higher), income (median income $40,000 to $49,000), race/ethnicity (76.5% white), and health consciousness. Respondents' race/ethnicity was measured by creating four dummy variables: non-Hispanic Caucasian, African American, Hispanic American, and other ethnic groups. *Health consciousness* consists of three four-point items (1 = "strongly disagree" to 4 = "strongly agree") that measured agreement with the following statements: "I think a lot about my health," "I try to do things to stay healthy," and "My health is important to me." These items were summed and used as a measure of health consciousness (α = .73; *M* = 10.28, *SD* = 1.59).

In addition, the regression models included health information acquisition from other sources to detect the pure effects of Internet use. These were measured on a four-point scale (1 = "not at all" to 4 = "two or more times a week") that asked respondents how often they read about health issues in newspapers or general magazines (*M* = 2.49, *SD* = 1.08), read special health or medical magazines or newsletters (*M* = 1.94, *SD* = 1.00), watched special health segments of television newscasts (*M* = 2.39, *SD* = 1.08), watched television programs (other than news) which address health issues or focus on doctors or hospitals (*M* = 2.16, *SD* = 1.05), and talked with family or friends about health issues (*M* = 2.80, *SD* = 1.02).

Analysis Procedures

To test the hypotheses, the current research conducted ordinary least squares (OLS) multiple regression analyses. All analyses were done with unweighted samples. The use of weights inflates standard errors and thus decreases sensitivity to effects. Since the current research focuses on testing a theory rather than on making claims about the national population, this tradeoff—greater statistical power for reduced confidence in representativeness—has been preferred.

Results

Table 1 shows the results from the OLS multiple regression analysis where health-knowledge score was regressed on education, Internet engagement, Internet use for health information, and the interaction terms between education, Internet engagement, and Internet use as well as on control variables. The first block accounted for 20.6% of the total variance of the dependent variable, with education, income, being African American, being Hispanic

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American, and being from other ethnic groups making a significant contribution. After these controls, the R^2 of the block for health information acquisition was 2.1%, with only general newspapers and magazines making a positive contribution. More importantly, even after adjusting for all these control variables, Internet engagement was positively associated with general health knowledge, explaining another 1.2% of the variance in knowledge (see Table 1). Notably, Internet use was not significantly related to health knowledge.

The first hypothesis posited that there is a gap between different education groups in terms of the extent to which they attain health knowledge from their Internet use. Although the effect size was small, the statically significant regression coefficient showed that one's education moderated the relationship between Internet use for health information and general health knowledge (see Table 1). That is, the association between Internet use and health knowledge was stronger for those with higher levels of education than for those with low levels of education. In other words, the health-knowledge gap due to education became larger as one's Internet use increased (see Figure 1).[6]

The current research posed another hypothesis that education is positively related to Internet engagement. To test this hypothesis, age, gender, race/ethnicity, and income were included as control variables. As Table 2 shows, education was significantly associated with Internet engagement. That is, the more educated one was, the more one engaged with the Internet. The current research further found that education was significantly related to each of the Internet-engagement measures (see Table 2).

Moreover, the link between Internet use and health knowledge was found to depend on how much one engages with the Internet (see Figure 2). The regression coefficient for the interaction term between Internet use and Internet engagement was quite small but statistically significant (see Table 1). The relationship between Internet use and health knowledge was stronger for those with high levels of Internet engagement than those with low levels of Internet engagement.

Discussion

The major goal of the current research was to examine one of the pathways from education to the health-knowledge gap on the Internet. To achieve this goal, the current research tested whether Internet engagement functioned as a moderator of the relationship between Internet use for health information and health knowledge. Overall, the results supported the main arguments of the current research. Thus, the current research helps us understand the mechanisms by which health-knowledge gaps occur on the Internet.

There are a few findings that should be highlighted in this context. First, the main effect of Internet use for health information on health knowledge was not statistically significant. This finding shows that the extent to which people learn from the Internet is not the same across different social groups. In line with findings regarding the knowledge gap in mass

[6]One concern is that a large number of Internet non-users may have biased the moderation pattern because the current research relies on older people. However, when Internet nonusers were excluded, the interaction effect remained statistically significant and its pattern was the same. This also applies to the case of Internet engagement.

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media, the current study found that education was a strong factor in determining the rate at which one can benefit from Internet use as well. Given that older adults tend to have a higher level of interest in health issues, the results of the current research confirm the importance of education in knowledge gaps despite the possible contingent role of motivational factors (Viswanath et al., 1993).

To identify the underlying reasons for this knowledge gap resulting from Internet use, the current research focused on the extent to which one engages with the Internet. Consistent with the expectation, one of the current study's findings was that Internet engagement moderated the association between Internet use and health knowledge. Also, education was positively related to Internet engagement. These findings demonstrate that, in addition to having physical access to the Internet, one should have a high level of Internet engagement in order to maximally utilize the Internet.

Second, the current research used the Internet-engagement scale to capture the qualitative, complex relationship that individuals have developed with the Internet. The current research joins other recent endeavors to measure the complex relationship that goes beyond Internet-search skills and Internet expertise (Bucy & Newhagen, 2004; Jung et al., 2001; Selwyn, 2004a). In this way, the current research tried to redress the limitations of "the conventional dichotomous notion of the digital divide" (Selwyn, 2004a, p. 341). In line with expectations, the current study found that scope of Internet activities, Internet-adoption period, compute-adoption period, Internet-use comfort level, computer-use comfort level, Internet-connection speed, scope of Internet sites, and Internet-use frequency were important in predicting the size of the effects of Internet use. Thus, the current research shows that "the digital divide issue is an ecological and multi-level phenomenon. It is not just a problem of individuals' choice of having or not having connections to the technological network nor is it the economic affordability of Internet services" (Loges & Jung, 2001, p. 538).

As outlined earlier, the current research acknowledges that there are other valuable ways to extend research agendas related to both the digital divide and the knowledge gap on the Internet. Some scholars have focused predominantly on skills necessary for such ICTs as the Internet, thereby refining the theoretical discussion about the types of Internet-use skills and exploring their antecedents and consequences. To extend these studies, the current research considered the environment of Internet use and Internet users' psychological states in addition to frequency of Internet use and types of online activities. Certainly, future studies could combine both of the approaches and thereby paint a more complete picture of the role that one's relationship with the Internet plays in explaining how one maximizes the benefits of the Internet.

Third, there were overall significant associations between SES and Internet engagement. This finding suggests that one mechanism of the health-knowledge gap on the Internet is the differential Internet engagement among SES groups. In line with the first digital-divide stage (the gap in physical access to the Internet), Internet engagement was dependent on SES (Freese et al., 2006; Livingstone & Helsper, 2007; Robinson et al., 2003). The tentative generalized conclusion is that highly educated, relatively young, relatively well-off White males are more likely than their low SES counterparts to have a longer history of Internet

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adoption, to engage in effective use of home-based Internet-connection facilities, to rely on the Internet for multiple purposes in multiple places on multiple occasions, and to feel comfortable when using computers and the Internet. Characteristics of the age range in the current research (40–70) may have exaggerated these patterns. Internet use is more prevalent and more a part of everyday life among younger adults and even children than among older adults, so the size assignable to the SES effect on Internet engagement might be smaller for younger people than for older adults. Thus, future studies could include a broader range of age groups to further examine what predicts Internet engagement.

The overall results of the current research are in line with recent studies (Livingstone & Helsper, 2007; Selwyn, 2004a; van Dijk, 2005) regarding the assertion that the digital divide consists of multiple layers. Thus, policy efforts to close the gap among SES groups should account for such dimensions of the digital divide as gaps in usage and in engagement as well as in access. Of course, persistent disparity in Internet access still poses the first threat to the benefits that can arise from the Internet as a new health-information educator. This disparity is a significant problem in U.S. health care because many people (namely, low-SES individuals), being both excluded from health information on the Internet and subject to serious disparities in health care, thus need health information to be widely available on the Internet (Lee & Hornik, in press). However, as the current research showed, removing the access barrier alone does not erase the disparities in Internet-based information acquisition. The crucial issue is to educate underserved people about how to build a close relationship with the Internet, a closeness that will ultimately help them both locate online health information and understand it (Cline & Haynes, 2001; Shaw et al., 2006).

Limitations

The current research has several limitations. First, because the current research relied on a cross-sectional dataset, the causal order cannot be confirmed. That is, it is possible that greater health knowledge spurs more Internet use rather than the reverse.

Second, one may argue that the health-knowledge items in the current research are not closely related to knowledge conveyed by media.[7] Considering that research on the knowledge gap has focused on information that flows through media channels, future studies should refine general health-knowledge items.

Third, it should be noted that the response rate for the sample is fairly low (16%); consequently, the claim for national representativeness is rather limited. However, this limitation is not critically problematic because weighting the original sample to the U.S. population distribution on crucial variables (e.g., gender, education, race-ethnicity, region, etc.) materially affected neither the distribution of the current research's critical variables nor the coefficients in the regression results.

Fourth, and related to the third point, because the current research focused only on adults between the ages of 40 and 70, the results are certainly limited in terms of their generalizability to the whole U.S. population. However, the narrow scope of the current

[7]I am indebted to an anonymous reviewer for this point.

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research is appropriate because the health-knowledge items in the current research were designed specifically for this age group and because this age group is more susceptible to a variety of health risks than are younger adults. Also, the current research helps fill a gap in the current literature, given that discussions of Internet use and subsequent knowledge gains tend to put more weight on younger adults than on older adults.

Finally, the scale of Internet engagement should be refined in future studies because the current research included only one dimension of psychological states related to Internet use (i.e., comfort level in using computers and the Internet). Not included in the current research are other possibly important psychological measures of, for example, motivation and technophobia. Also, the current research measured only the places where individuals use computers. However, as technologies advance, platforms for Internet connection will grow more diverse (DiMaggio et al., 2004; Selwyn, 2004a; van Dijk & Hacker, 2003). Then, other interfaces like mobile telephones, digital televisions, and personal digital assistants (PDAs) should be included in future studies.

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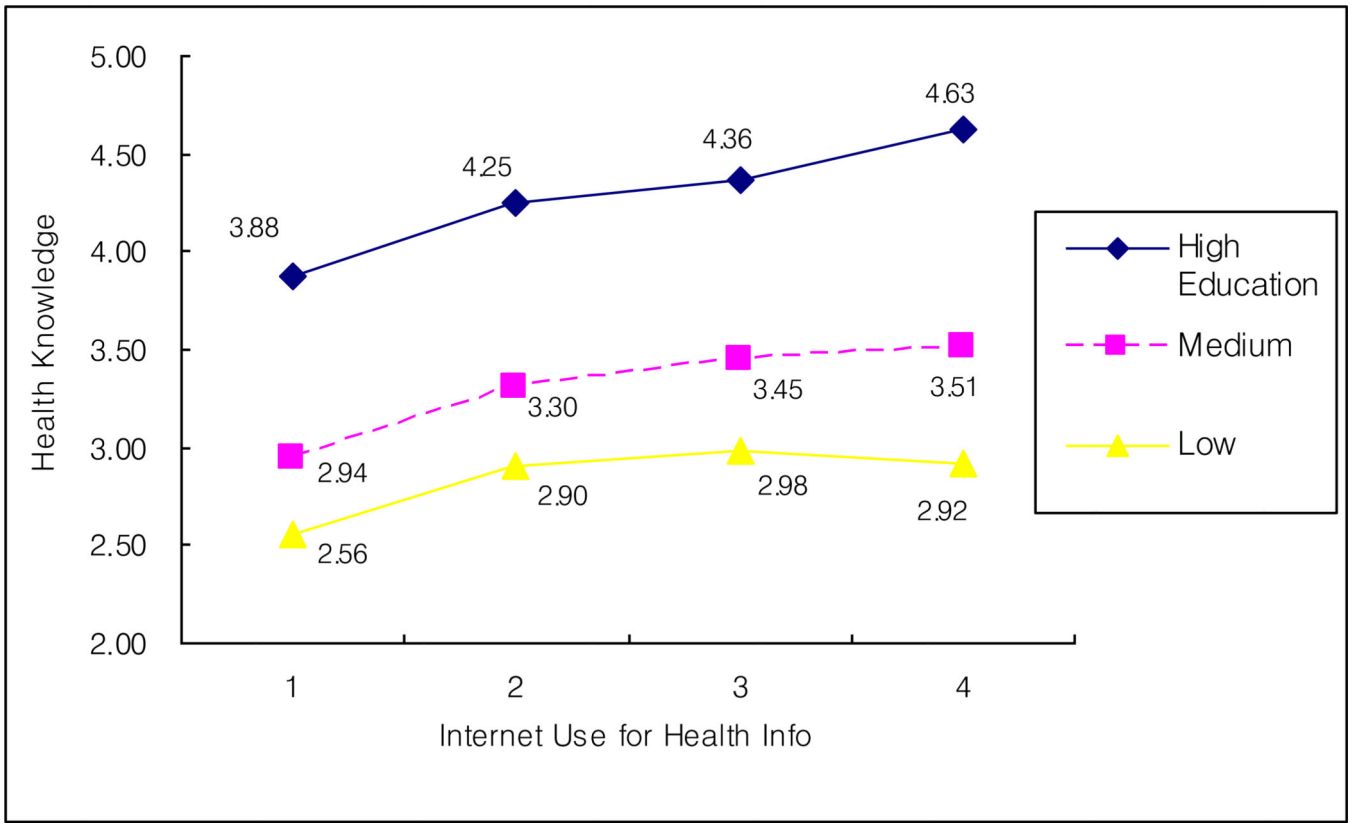

Figure 1.

Predicted Health Knowledge: Moderating Role of Education on Internet Use for Health Information

Notes: “High Education” = “college graduate or more advanced,” “Medium” = “some college or technical school,” and “Low” = “high school graduate or lower”; “1 Internet Use for Health Information” = “not at all,” “2” = “less than once per week,” “3” = “once per week,” and “4” = “two or more times per week.”

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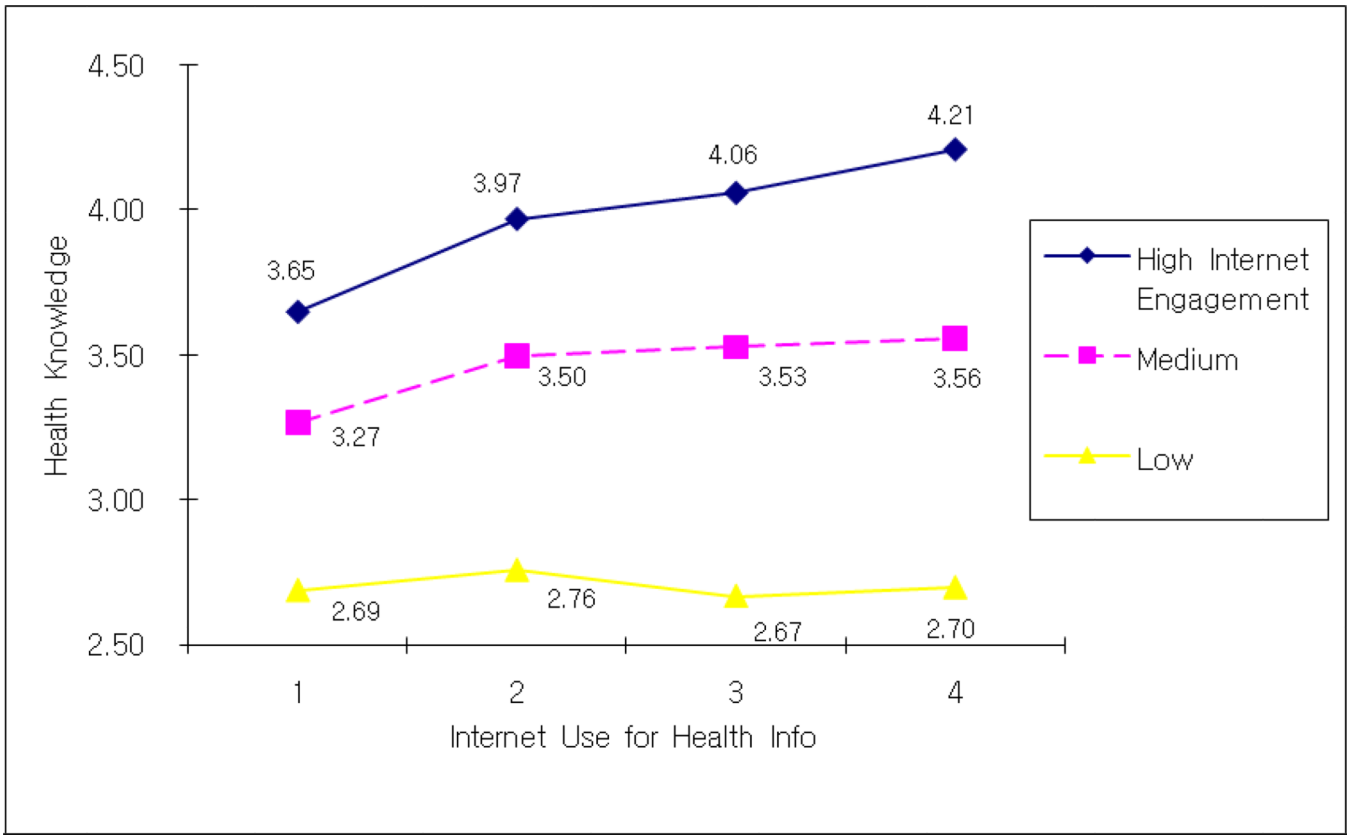

Figure 2.

Predicted Health Knowledge: Moderating Role of Internet Engagement on Internet Use for Health Information

Notes: “High Internet Engagement” = the top 33.1 % of respondents on the distribution of the Internet engagement scale, “Medium” = the middle 33.5 %, and “Low” = the bottom 33.4 %; “1 Internet Use for Health Information” = “not at all,” “2” = “less than once per week,” “3” = “once per week,” and “4” = “two or more times per week.”

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Table 1

OLS Regression Analysis Predicting General Health Knowledge

Variable	Zero-order Correlation	Before-entry Beta	Final Beta
Step 1			
Age	.08***	-	.03
Gender (female=0, male=1)	.02	-	−.04
Education	.36***	-	.26***
Income	.29***	-	.11***
African American	−.21***	-	−.19***
Hispanic American	−.04*	-	−.07***
Other Ethnic Groups	−.04*	-	−.06**
Health Consciousness	.01	-	.01
Incremental R^2 (%)		20.6***	
Step 2			
General Newspapers and Magazines	.20***	.14***	.12***
Special Health/Medical Magazines and Newsletters	.09***	.07***	−.02
TV News	.07***	.10***	.05
TV Shows other than News	.02	.08***	.01
Interpersonal Health Communication	.11***	.08***	.02
Incremental R^2 (%)		2.1***	
Step 3			
Internet Use for Health Information	.16***	.04	−.02
Internet Engagement	.30***	.12***	.14***
Incremental R^2 (%)		1.2***	
Step 4			
Internet Use × Education		.05*	-
Internet Use × Internet Engagement		.04*	-
Incremental R^2 (%)		.3**	
Final R^2 (%)			24.1***

Notes: N = 2,113.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

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Table 2

OLS Regression Analysis Predicting Internet Engagement

	Internet Engagement	Activity Scope	Adoption Period	Use Frequency	Comfort Level	Internet Speed	Site Scope
Age	−.07***	−.08***	−.03	−.03	−.09***	.01	−.13***
Gender	.01	.04*	−.03	−.02	−.03	.04*	.01
Hispanic	.01	.02	−.03	.03	−.01	.03	.00
Other Ethnic	−.01	.00	−.03	.00	−.02	.00	−.00
Black	−.11***	−.08***	−.11***	−.08***	−.09***	−.07***	−.06**
Income	.31***	.23***	.25***	.20***	.16***	.35***	.24***
Education	.25***	.20***	.24***	.22***	.22***	.05**	.24***
R^2 (%)	24.1***	15.2***	18.4***	13.2***	11.6***	16.2***	18.2***
N	2,228	2,375	2,281	2,454	2,317	2,364	2,381

Notes: Betas are final standardized regression coefficients.

$p < .05$.

** $p < .01$.

*** $p < .001$.

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